Insurance Sector Vulnerabilities to Climate Change

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Environment & Public Policy Track

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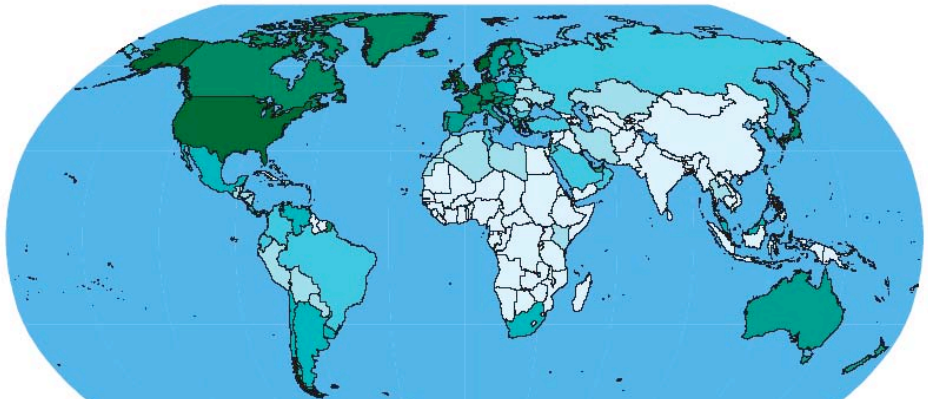
Why Link Insurance & Climate Change?

- **Importance**
  - World's largest industry: $3 trillion/year in revenues (= 3x "oil")
  - Mechanism for risk averaging (financial)
  - Mechanism for risk management (physical)
  - Provides a global "observing" system
  - Complements science
- **Concerns**
  - Vulnerability to climate change; dangerously uses past as proxy for future
  - Increased losses threaten affordability (more uninsured)
  - Health/life risks largely unknown; unaddressed
  - Insurability/solvency in question
  - Regulation can be obstacle to "doing the right thing"

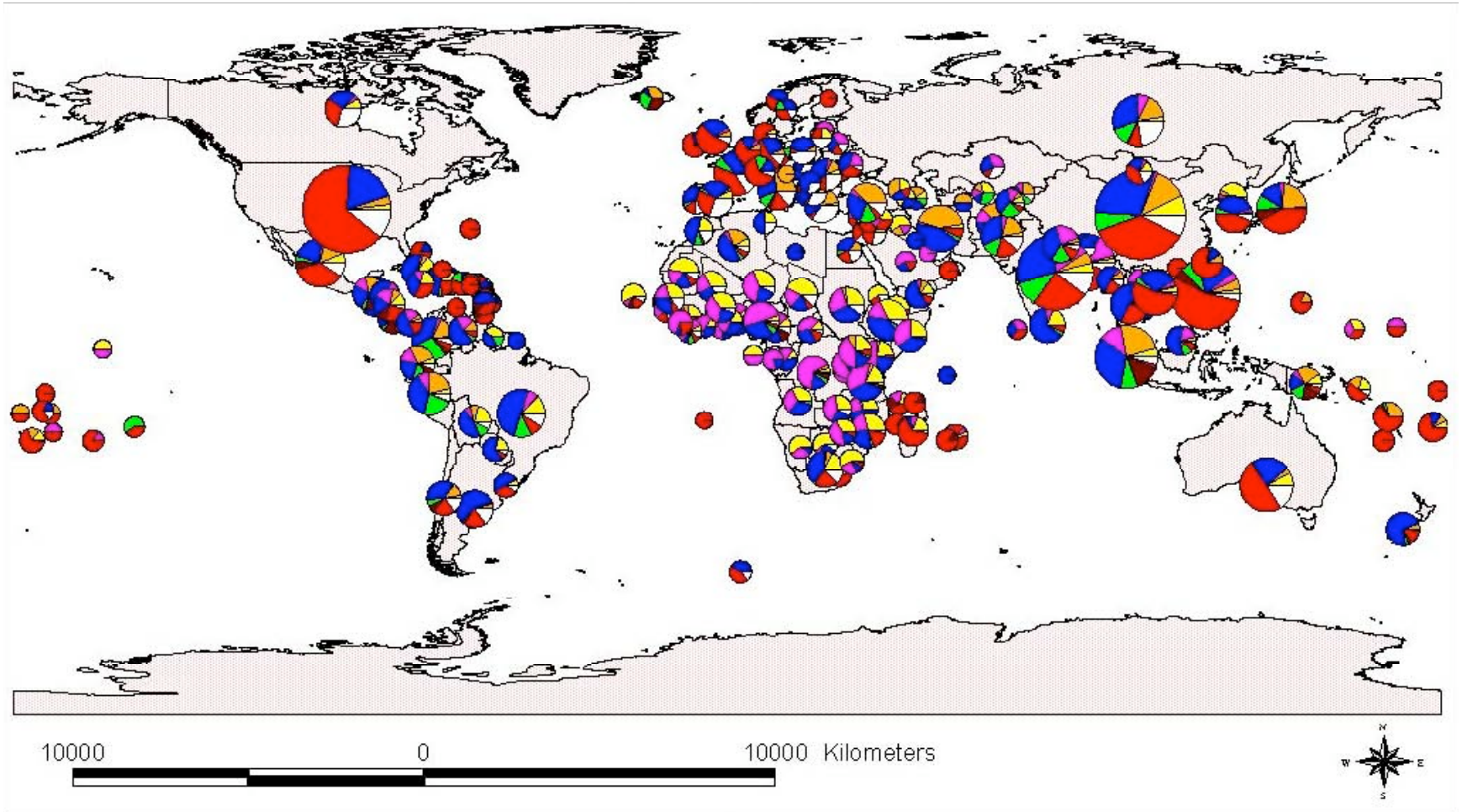
Insurance = Adaptive Capacity

- Major (and growing) means of spreading and managing the risks of extreme weather events -- today covers 20% of all weather-related damages
- Rapidly growing in developing world and economies in transition
- Availability and penetration varies widely

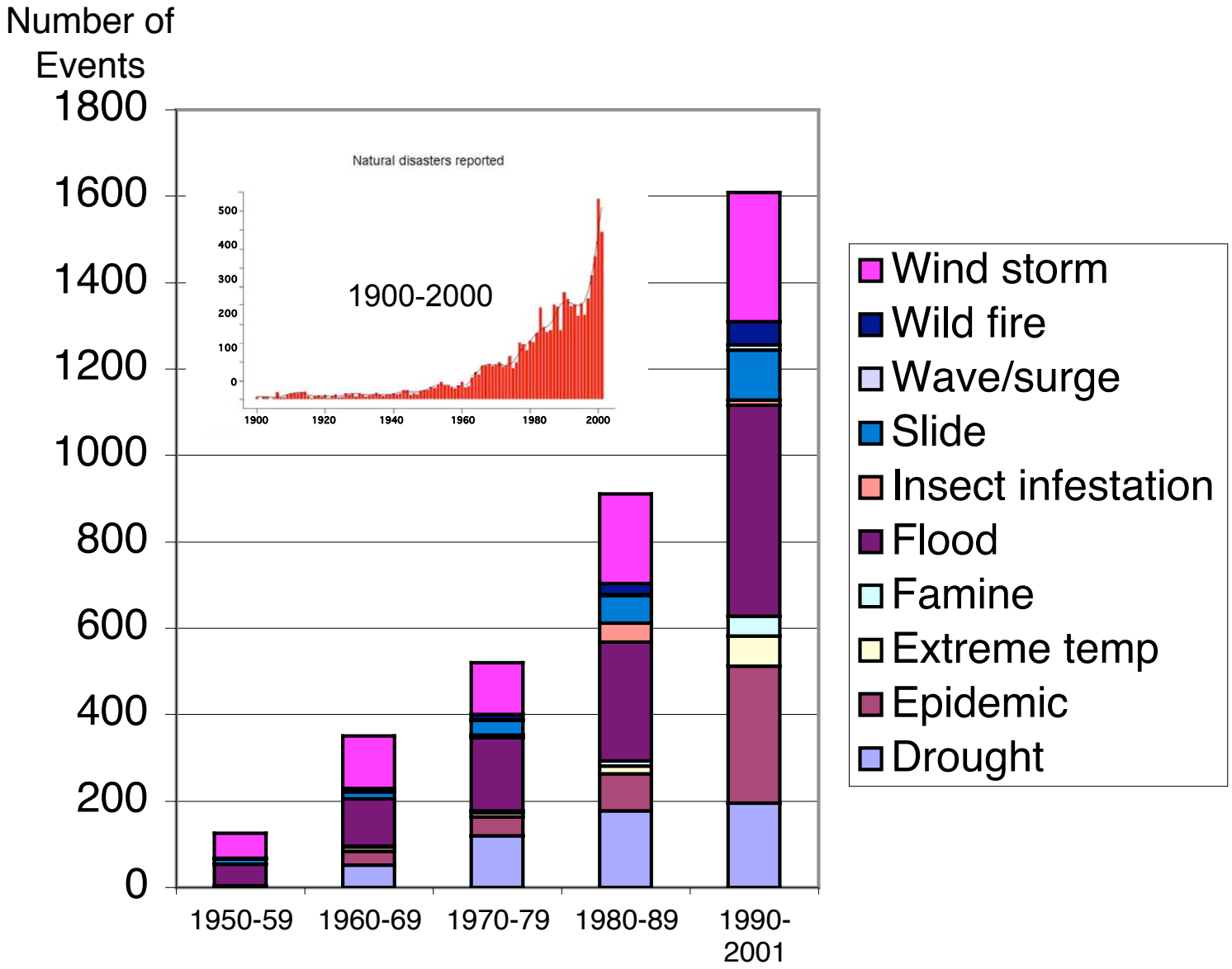


Premiums/capita-year highest in densely shaded areas ($5-$1000/capita-y)
Munich Re (2003)

The Type and Scale of Natural Disasters are Distributed Unevenly: 1975 to 2001



Changing Nature and Structure of Events



Sources: OFDA / Center for Research in the Epidemiology of Disasters (CRED) Intl database of Disasters

Spreading of Economic Costs

Weather Risks Are Spread in Five Directions

Insurers & Reinsurers
- Domestic
- Foreign

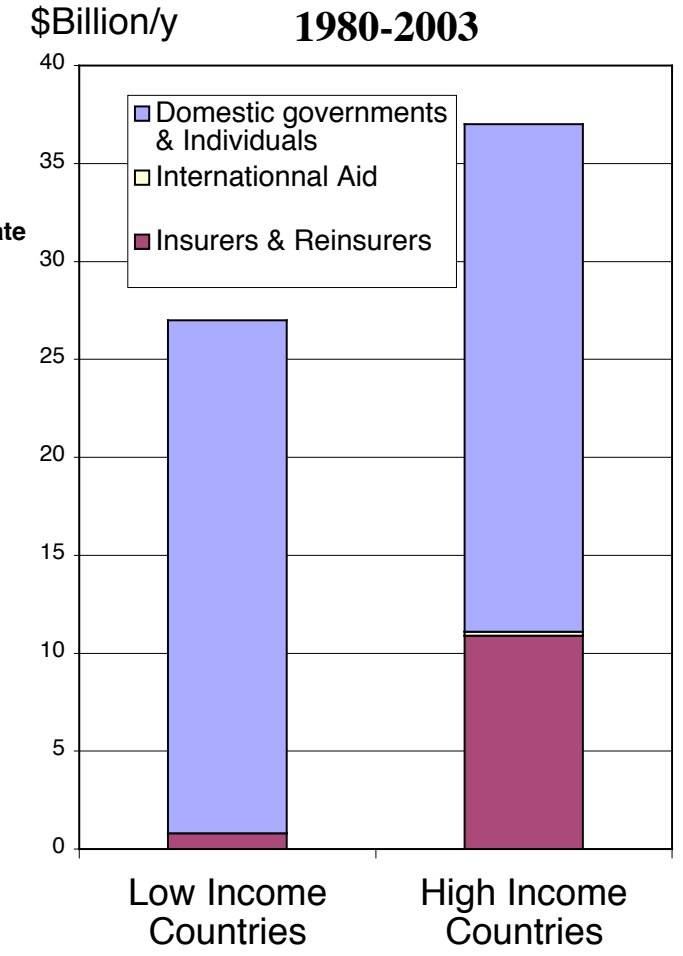
National/Local Governments
- Federal
- State
- Local
- Village

Non-Governmental Organizations & Private Donors
- FAO
- Red Cross
- CARE
- Private foundations
- etc.

Foreign Governments & The United Nations
- Bilateral Aid (e.g. USAID)
- UNOCHA
- UNICEF
- UNDP
- etc.

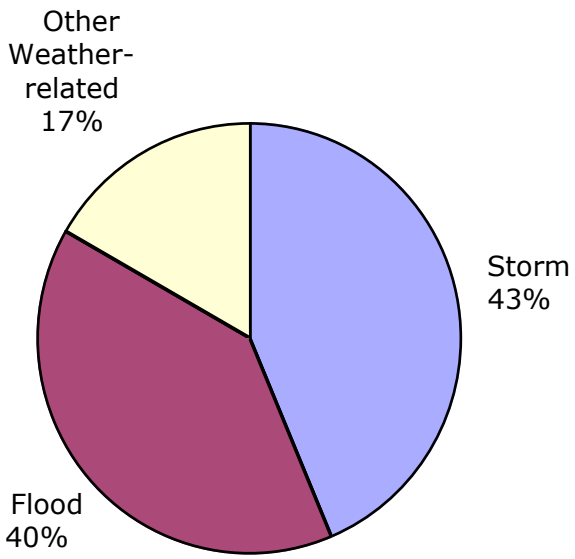
Individuals & Firms, as "self-insureds"
- Householders (informally)
- Companies (formally)

Costs of Weather-Related Natural Disasters

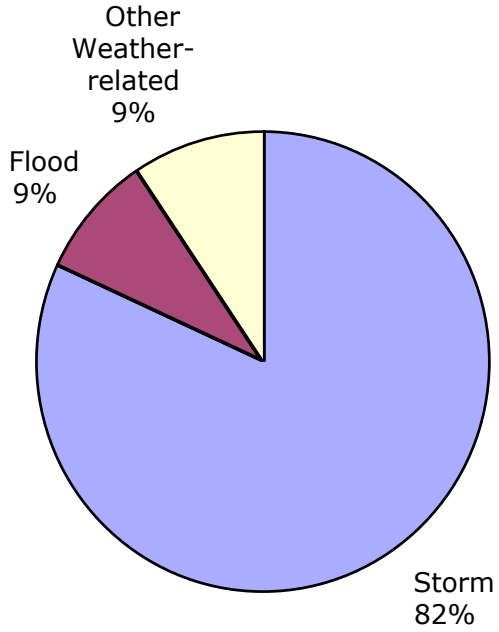


Financial "Lenses"

Total Economic Losses, Weather-Related Natural Disasters: $707 Billion (1985-1999)



Insured Losses, Weather-Related Natural Disasters: $141 Billion (1985-1999)



Source: Munich Re (2002)

The difference between total and insured losses is taken up by governments, ngo's, self-insurers, and individuals -- insurers *select* risks; don't accept all

Dynamics of Risks, Uncertainties, and Losses

Natural Phenomenon

(e.g. temperature increase)

Variability/Uncertainty

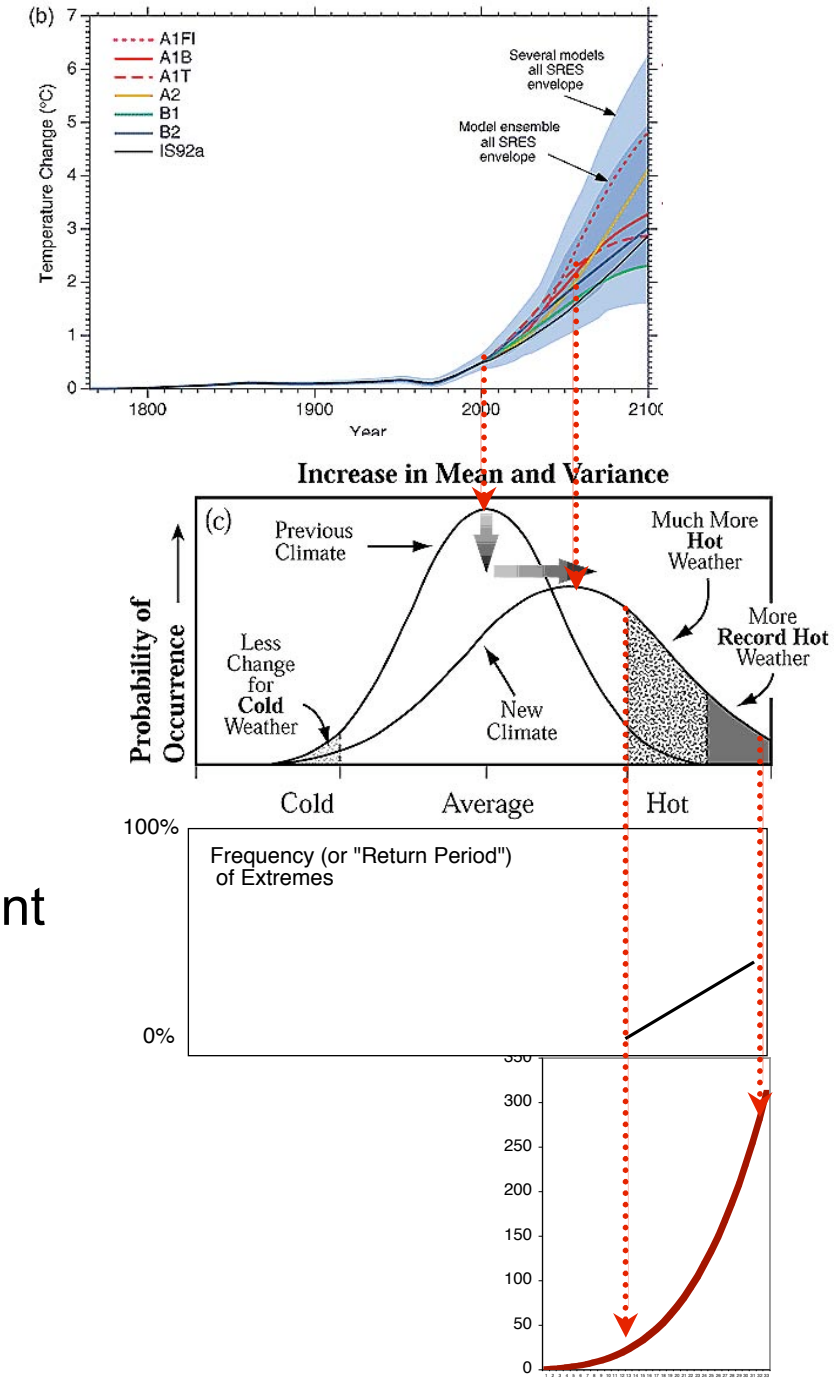
(e.g. heatwaves)

Change in Likelihood of Extreme Event

(e.g. return period)

Impact / Insured Loss

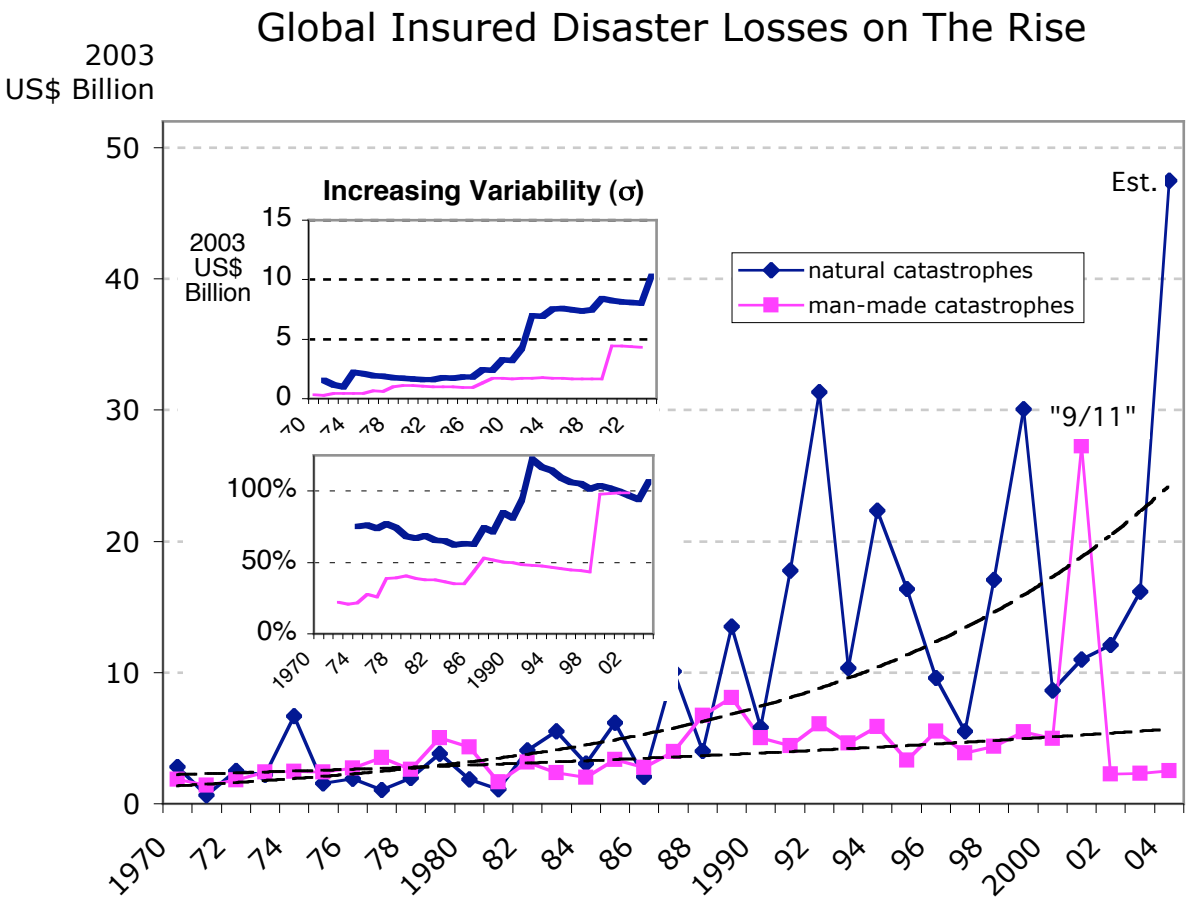
(e.g. loss of life; business interruption, etc.)



Uncertainty: Physical ⇨ Financial

"Catastrophe insurers can't simply extrapolate past experience."

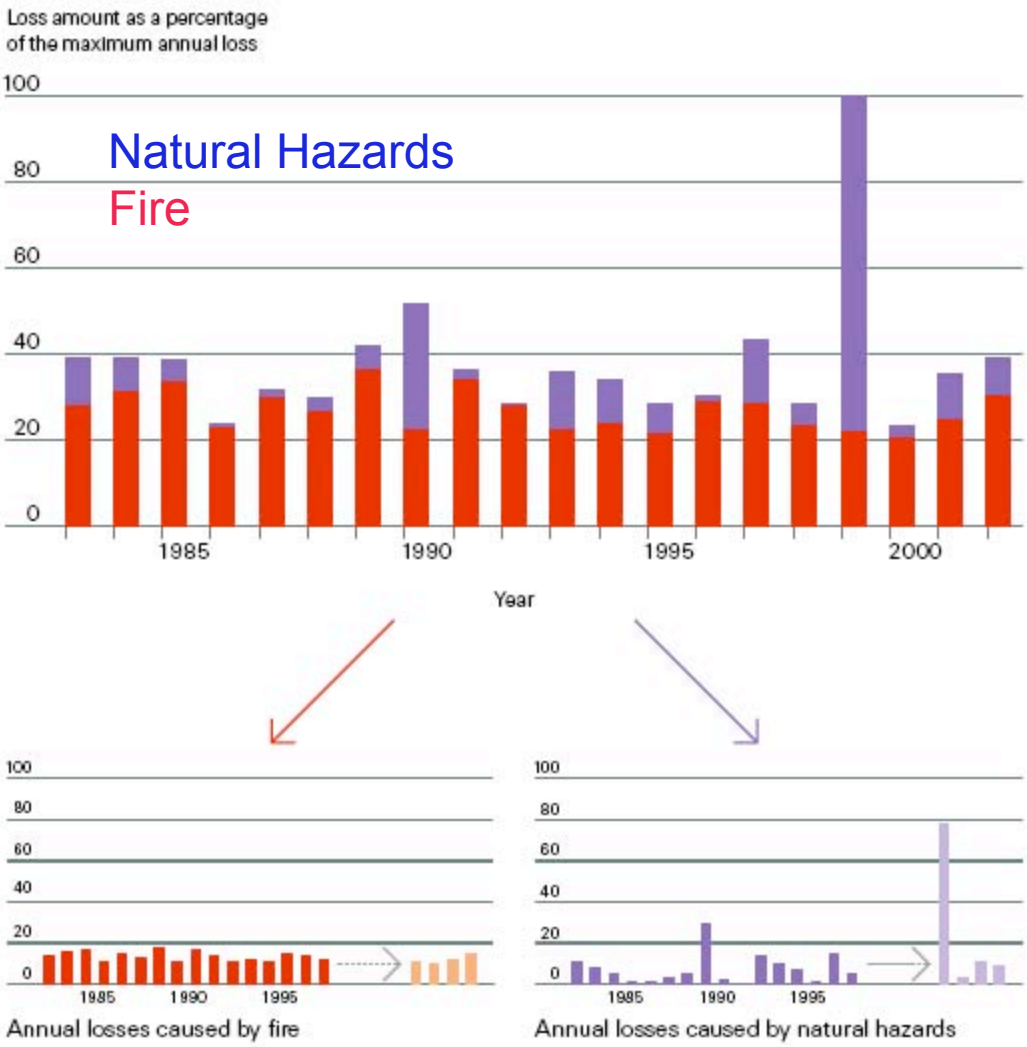
- Warren Buffett (1992)



Note: plot shows only large events and excludes health/life losses. Including small-scale events would double these numbers; health-related losses unknown

Source: Swiss Re (*Sigma*)

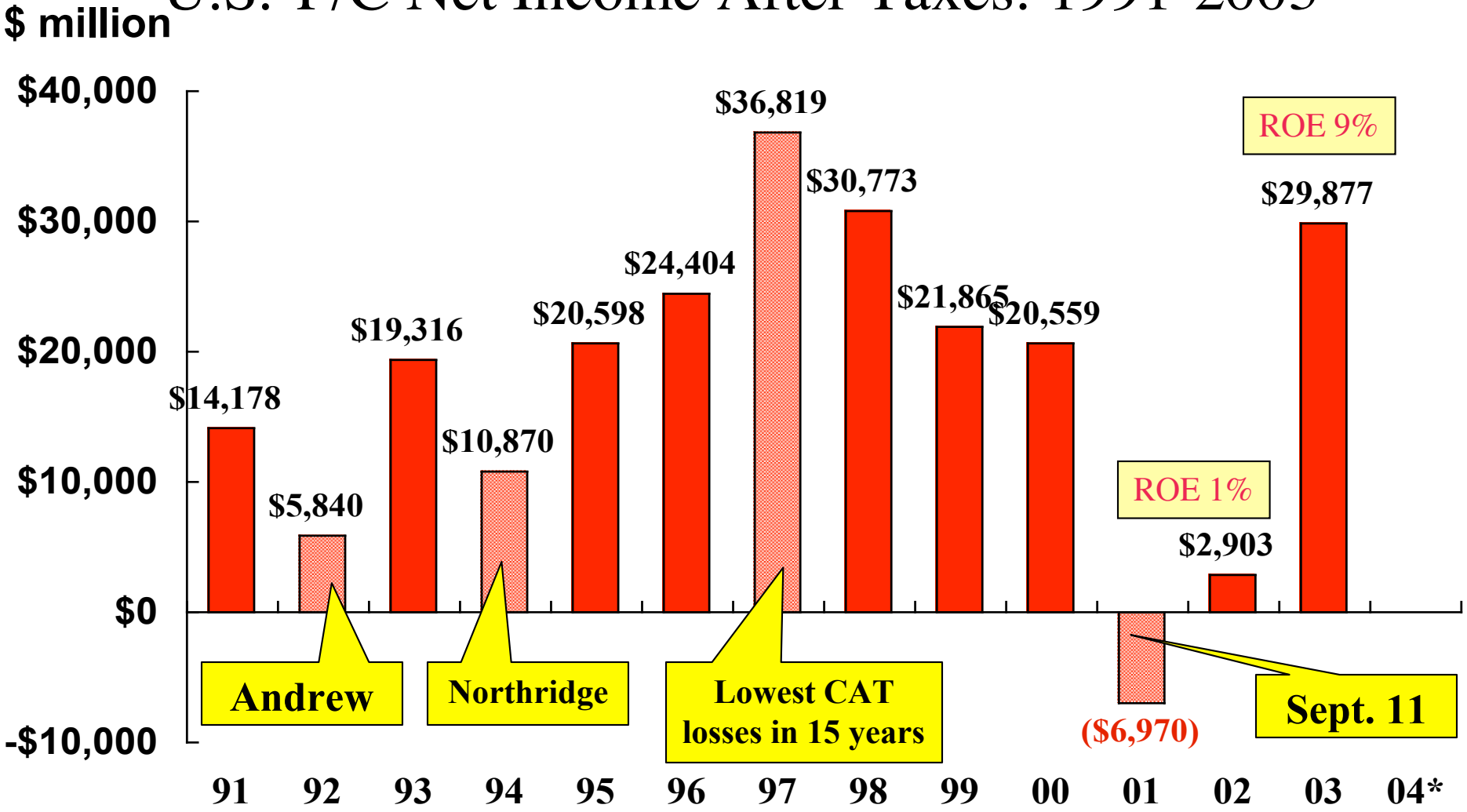
Variability



Source: Swiss Re (2002)

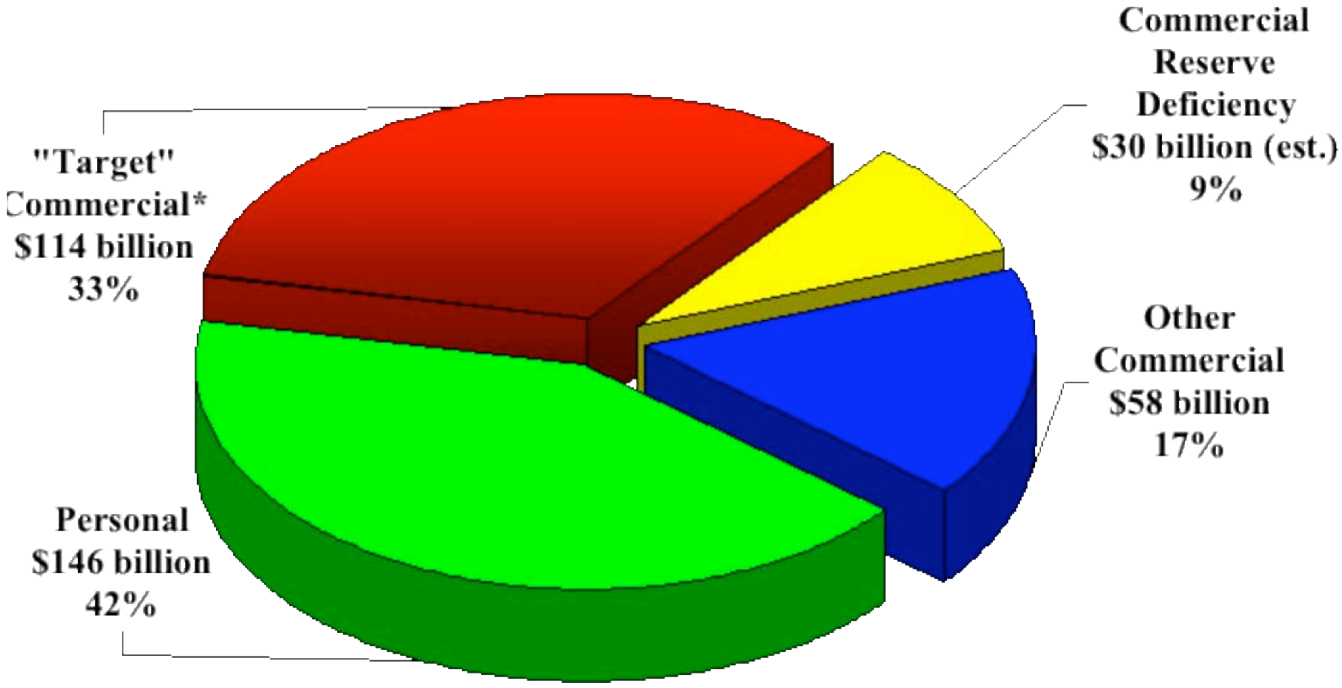
"CAT" Losses are Material for Insurers

U.S. P/C Net Income After Taxes: 1991-2003



Sources: A.M. Best, ISO, Insurance Information Institute (Robert Hartwig)

Capital Myth: $300 Billion Available to Pay Losses

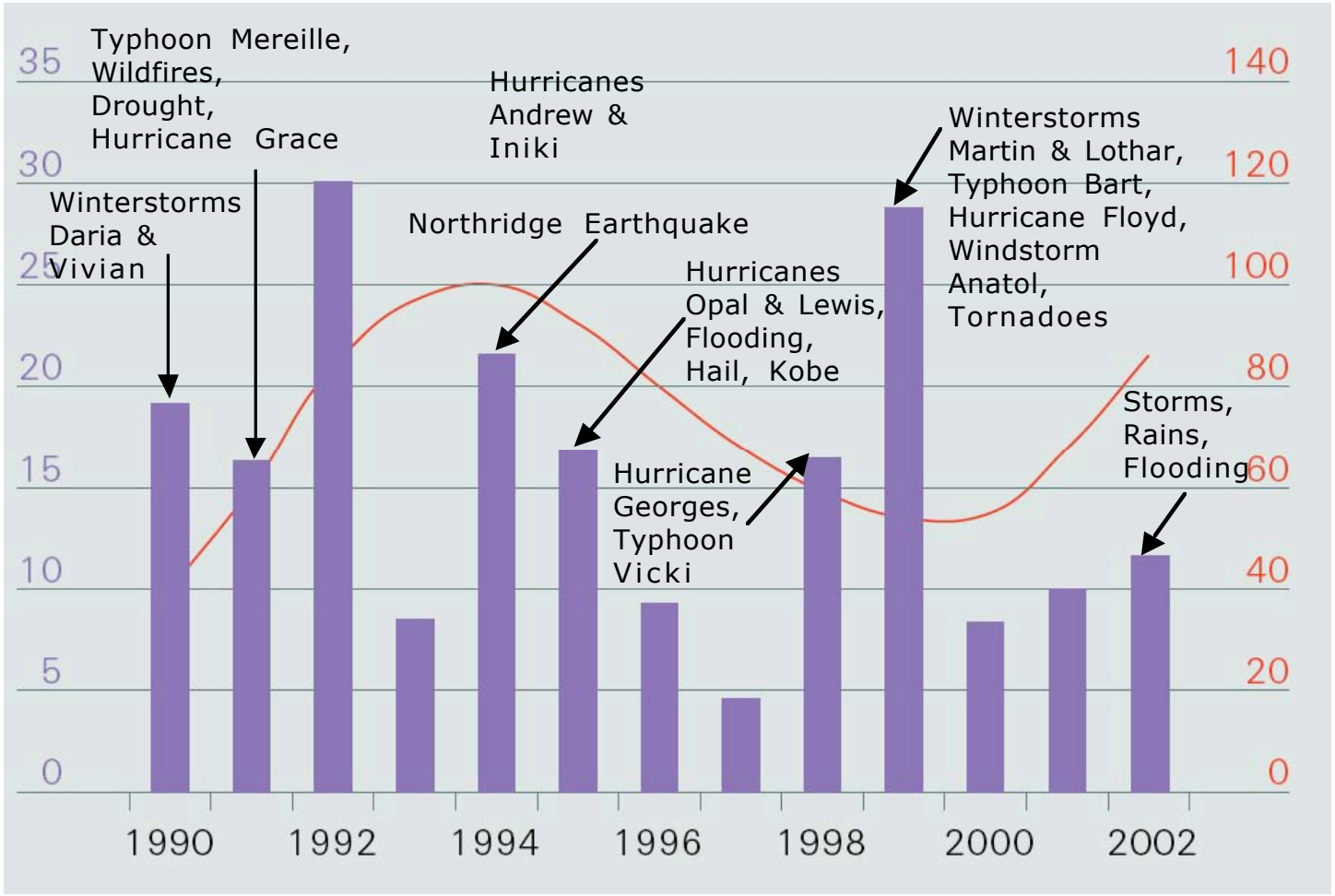


Surplus not pooled across companies. Must also back-up non-disaster related property/casualty claims and non-weather claims (e.g. terrorism). Surplus fluctuates -- sometimes significantly

Source: Insurance Information Institute estimates based on A.M. Best Q.A.R Data. (Robert Hartwig, III)

Reinsurance Pricing Reflects Losses & Uncertainty

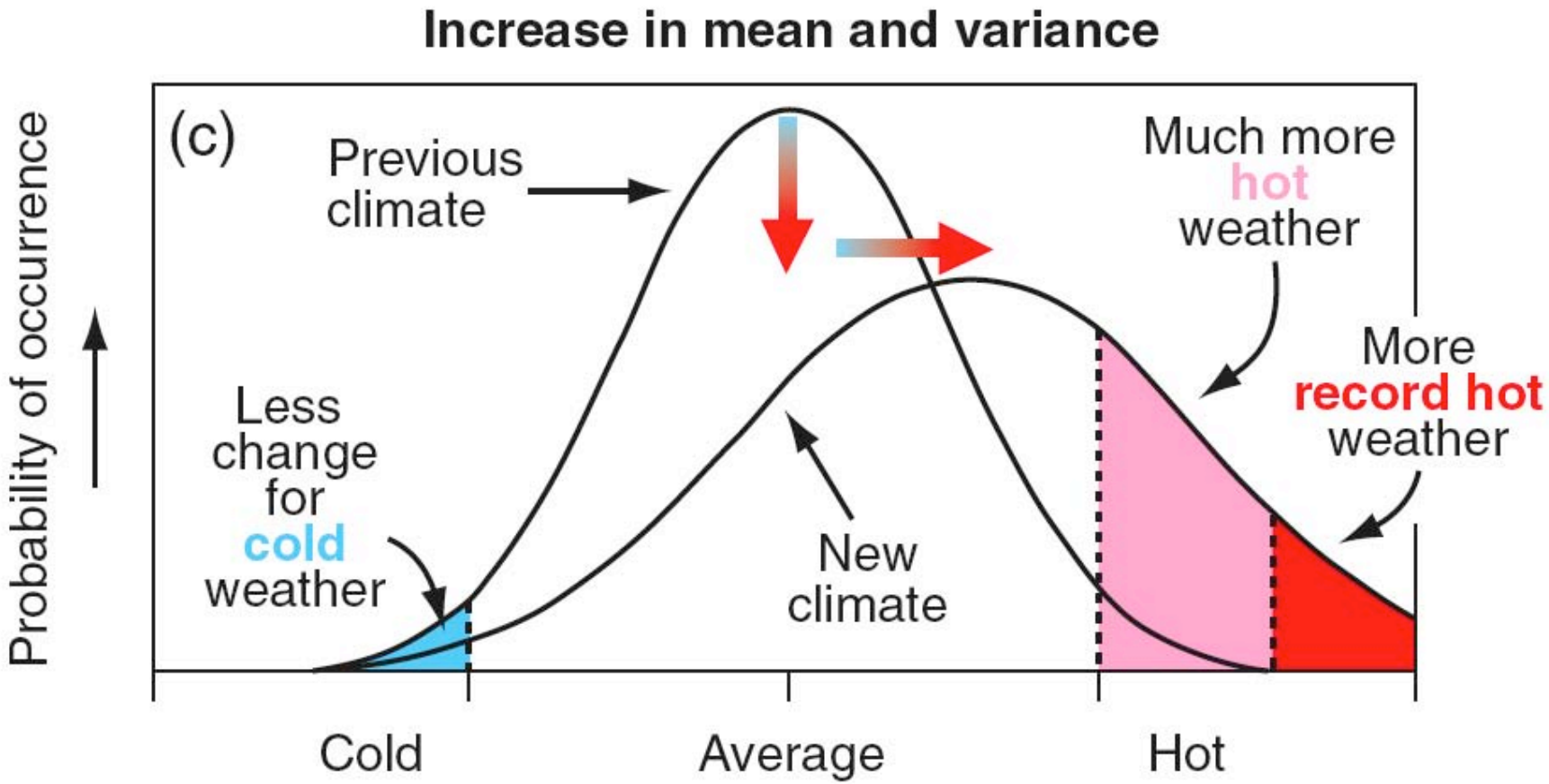
Losses ($B)
(bars)



Reinsurance
Price Index
(curve)

Source:
Swiss Re

Changes in Extremes

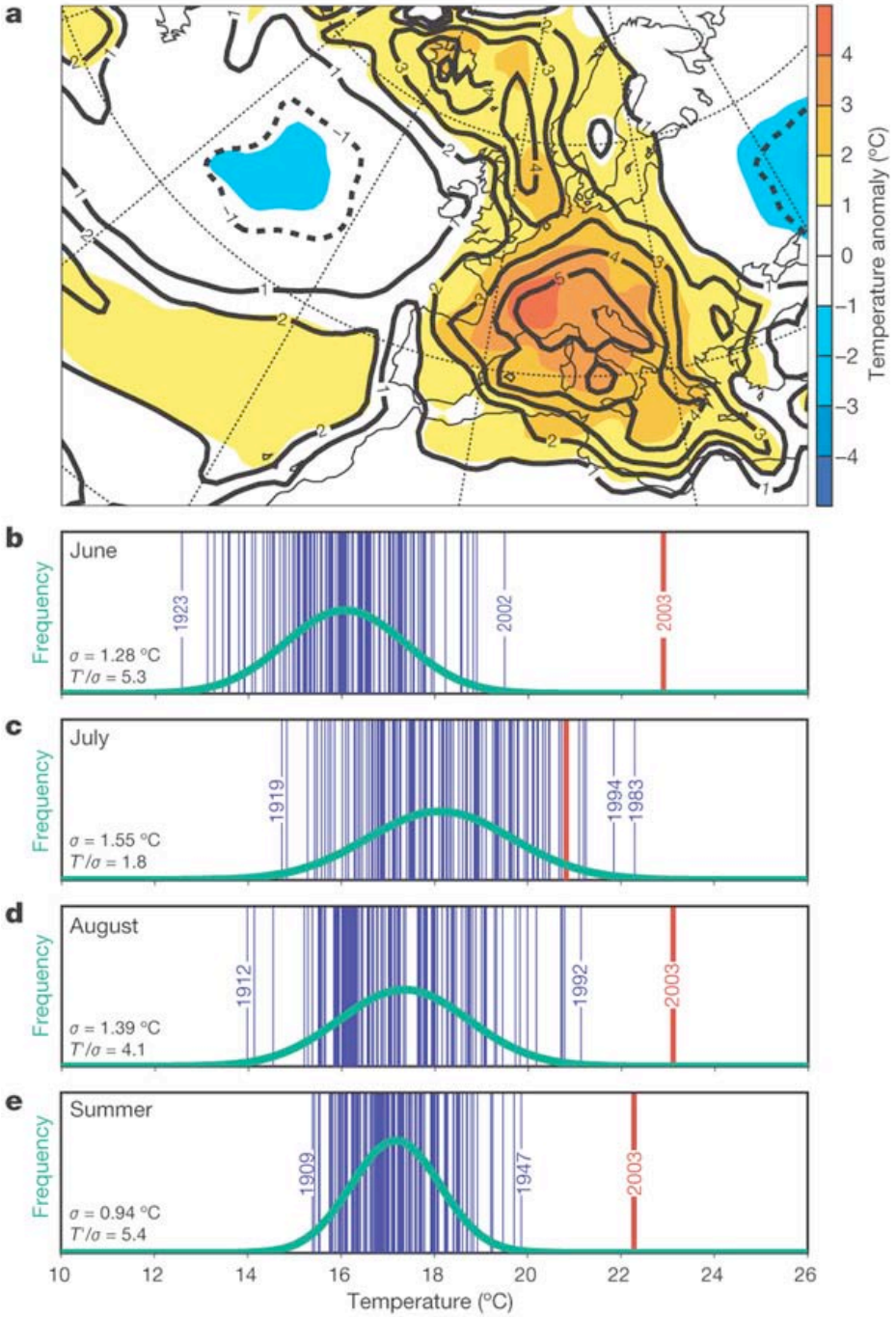


Source: IPCC, Third Assessment Report

Example: the 2003 European Heat Wave:

(hottest summer since 1500 AD)

- 22,000-35,000 human fatalities
- $13.6B in crop losses
- $1.7B in wildfires in Portugal alone + respiratory illness
- Nuclear power plant curtailment (insufficient cooling water)
- Unhealthy air masses (smog, particulate)



(a) Europe summer temperature anomaly with respect to 1961-1990 mean.

(b-e) Distribution of Swiss monthly and seasonal summer temperatures for 1864-2003.

Green: Fitted Gaussian distribution; Red: 2003

Source: Schar 2004 (*Nature*)

Vulnerabilities: Physical

- Disproportionately increasing damage functions:
  - 4x increase in wind damage for every 2x of wind speed
  - Increase in torrential precipitation: 1-in-100 year flood comes every 15 years
  - 1.4x increase in lightning for 1 deg-C increase in air temperature
  - 4x increase in wildfire damages in some areas under 2xCO2
  - *Current* warming has led to 2- to 4-times likelihood of extreme heatwaves, e.g. Europe 2003 (increase 100x in next 4 decades)

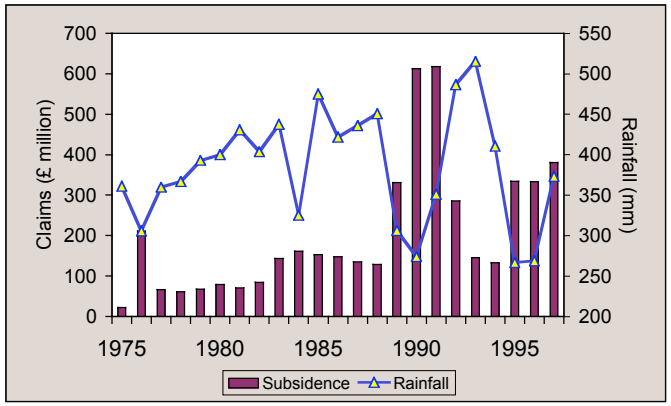
Vulnerabilities: Financial

- Underwriting
  - profitability/solvency (insufficient reserves)
  - volatility (unpredictability)
  - simultanaeity (drought and flood)
  - correlation (drought-wildfire; financial markets)
  - surprise (e.g. Directors & Officers liability)
- Broader Business
  - financial market conditions
  - real estate holdings
- Market Power
  - slowed/shrinking markets (voluntary/involuntary)
  - reputation

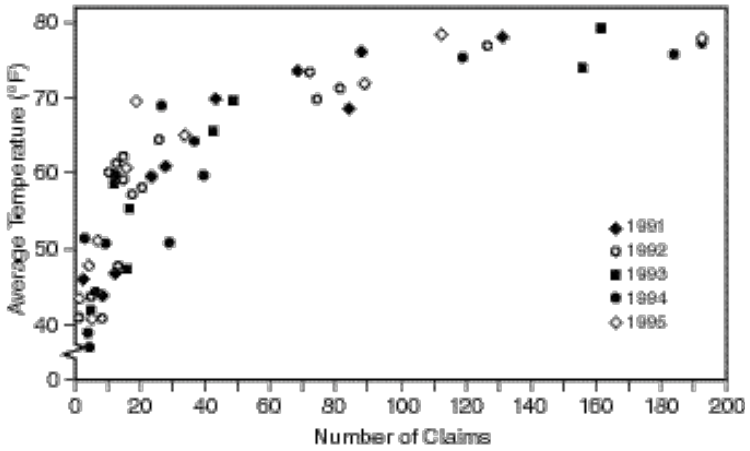
Small-scale, Gradual, and Indirect Events Often Overlooked

- **Small-scale**
  - Subsidence, Lightning, Hail, Wildfire, Equipment Breakdown
- **Gradual**
  - Sea-level rise, Drought, Infectious diseases
- **Indirect**
  - Erosion of water quality
  - Erosion of air quality
  - Health (human, crops, etc.)
  - Amplification of poverty (slows market growth; political risk)

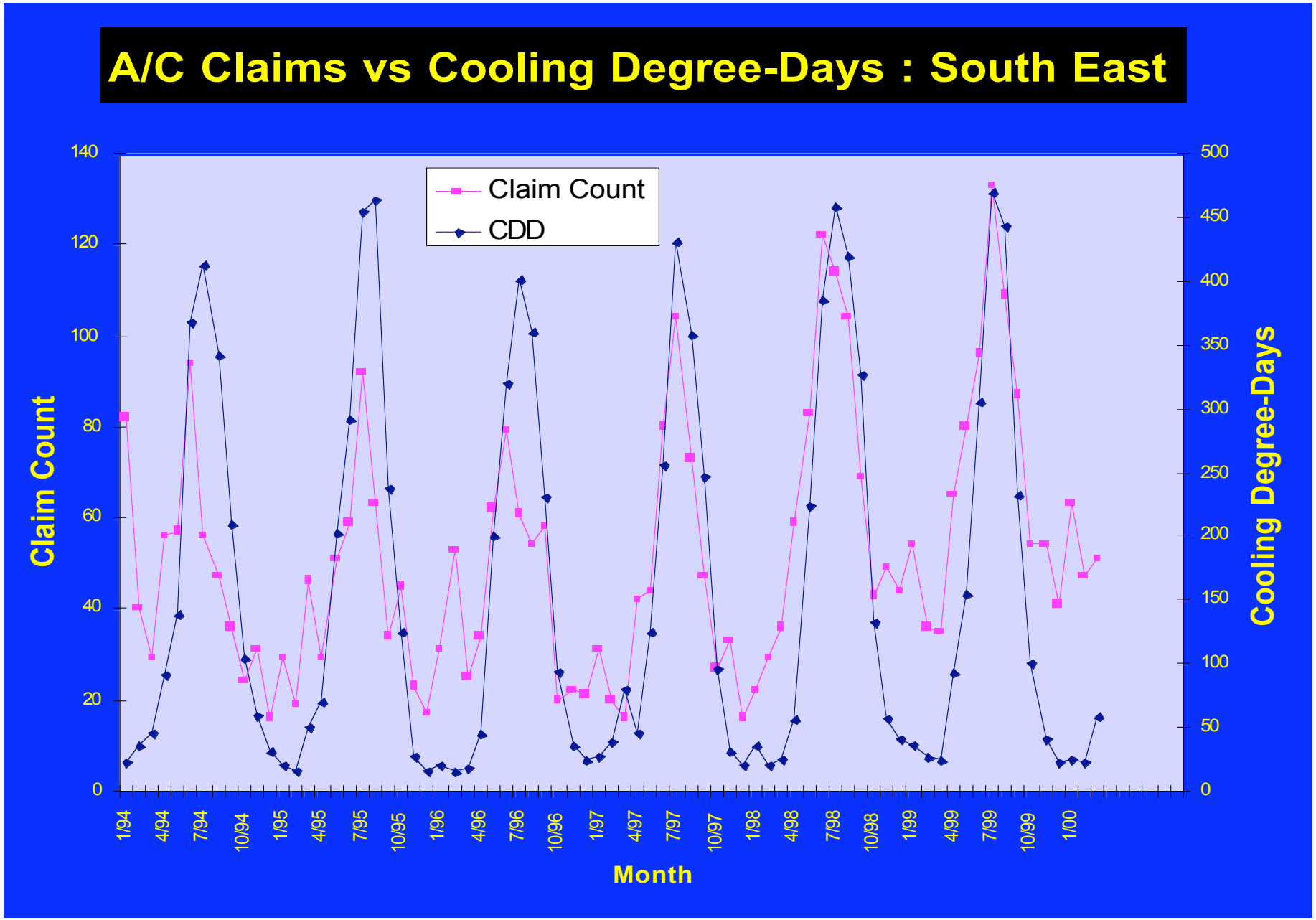
Subsidence claims increase with drought



Lightning-related claims increase with temperature



Source: Hartford Steam Boiler Inspection and Insurance Co. claims data (2000).
Each symbol represents a lightning storm event

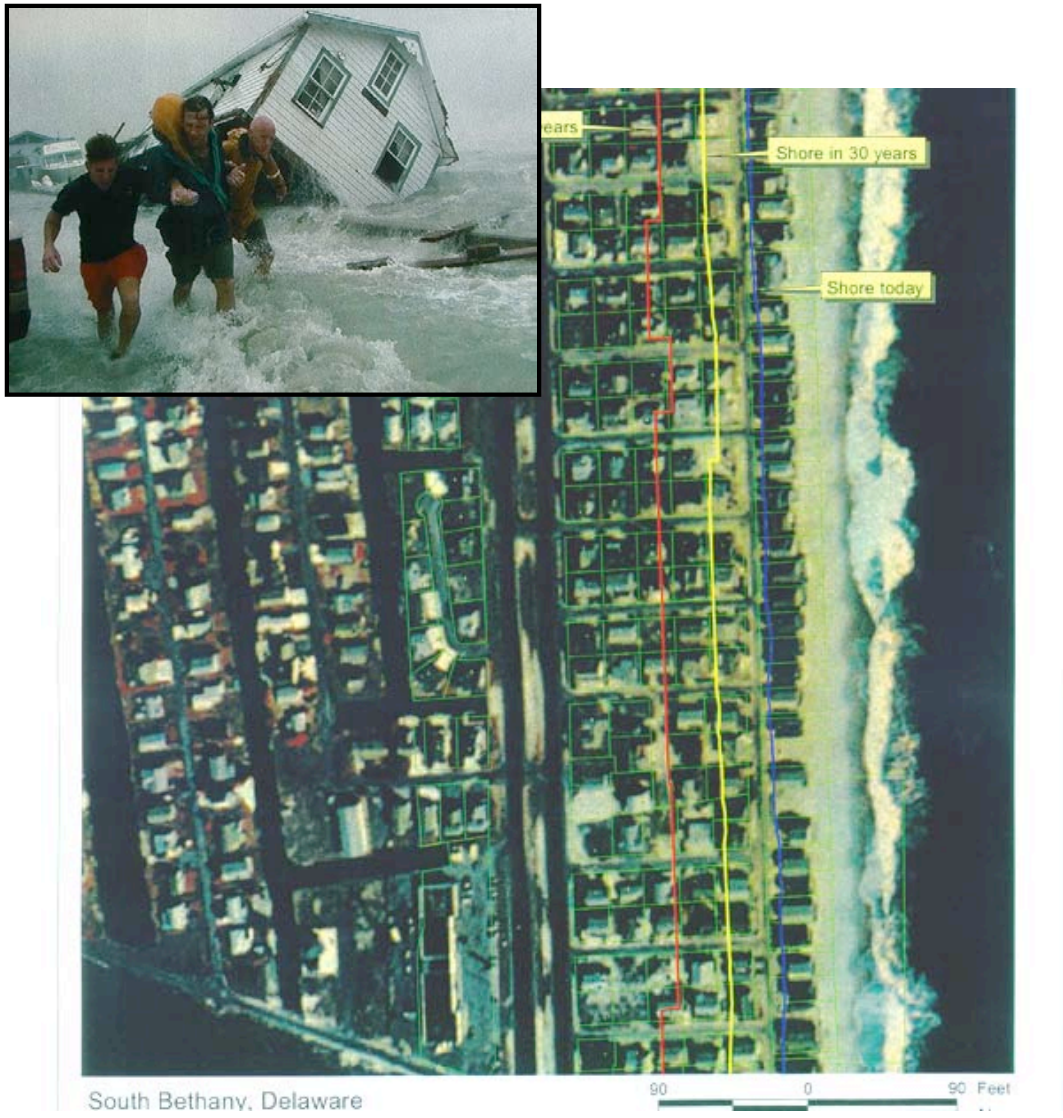


Source: Hartford Steam Boiler Insurance and Inspection Co, 2001

Sea-level Rise

- Figure: 60-year coastal erosion outlook for South Bethany, Delaware -- 3 rows of homes to be lost

- 25% of homes within 150 yards of current high-tide mark at risk over next 60 years. Water quality. Wetlands.

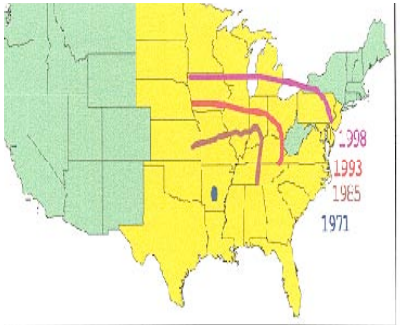


Source: Heinz Center (for FEMA)

Health

- Heat catastrophes
- Pollen/Mold - health; liability ($5B)
- New diseases: Nipah virus - highly contagious; lethal in > 40% of cases
- Insect super-infestations
- Crop diseases
- Coral bleaching - coastal protection; tourism; fresh water salinization

Pine beetle superinfestations



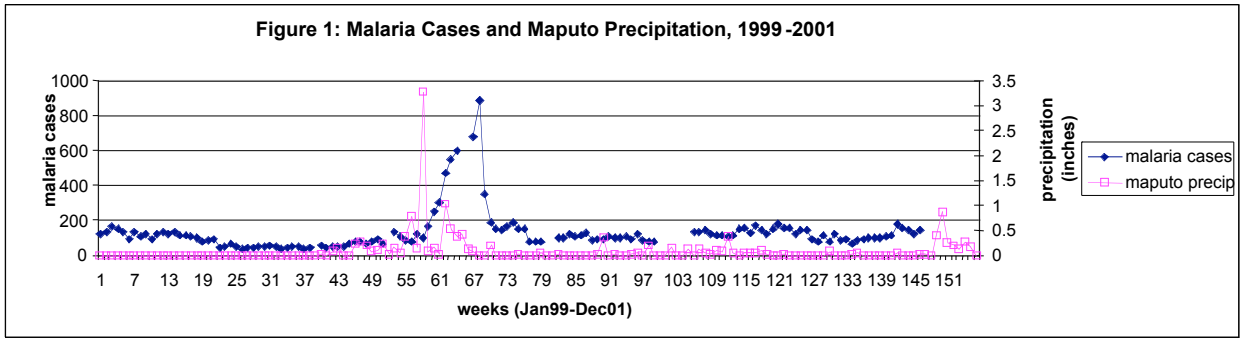
Expanding range of soybean rust: 1971-1998

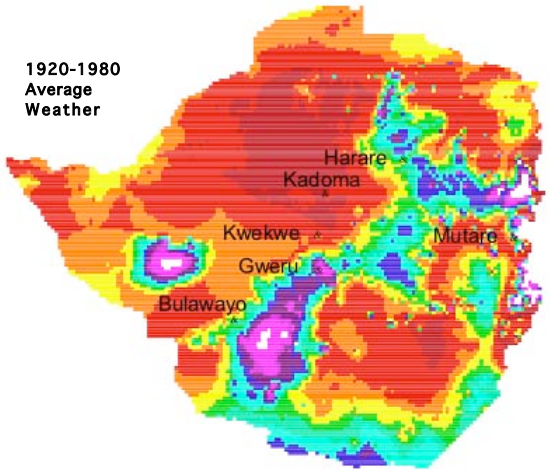
Coral bleaching

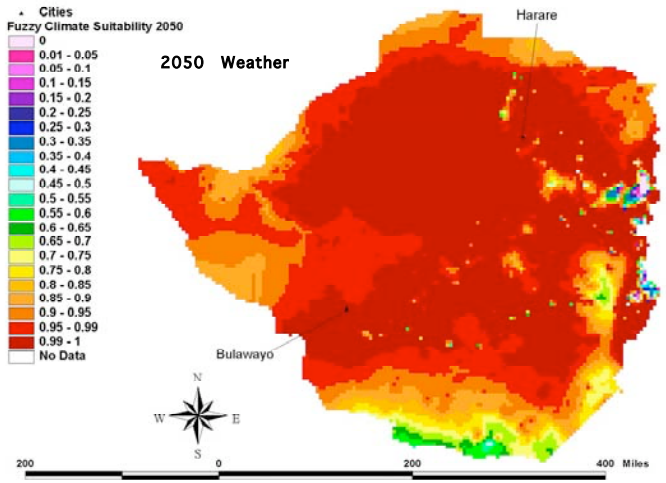
Vector-born Diseases: Malaria

- Outbreaks following extreme rainfall events: more of which expected under climate change: Maputo, Mozambique

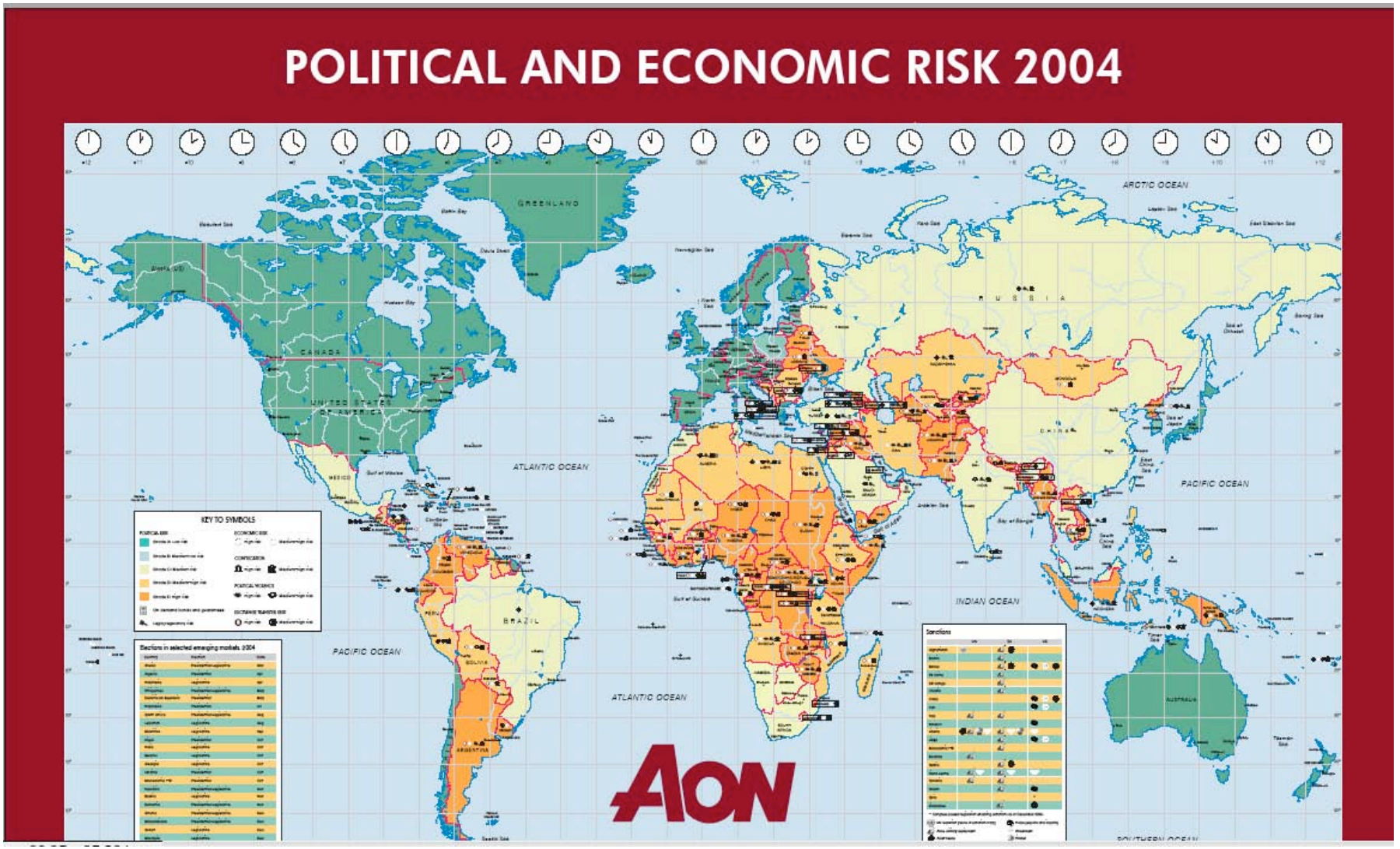
- Changes in Range: Zimbabwe







Source: Ebi et al (2004)



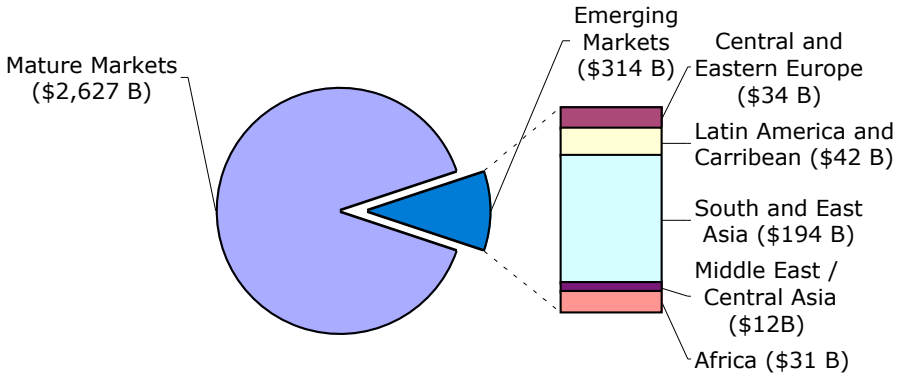
- Relevant weather-related risks include: Civil unrest, supply-chain disruption, resource-related conflict, government actions
- Level of risk tied to degree and effectiveness of post-event public-sector efforts

Source: www.aon.com/politicalrisk

Emerging Markets are the Future of Insurance, and are Particularly Vulnerable

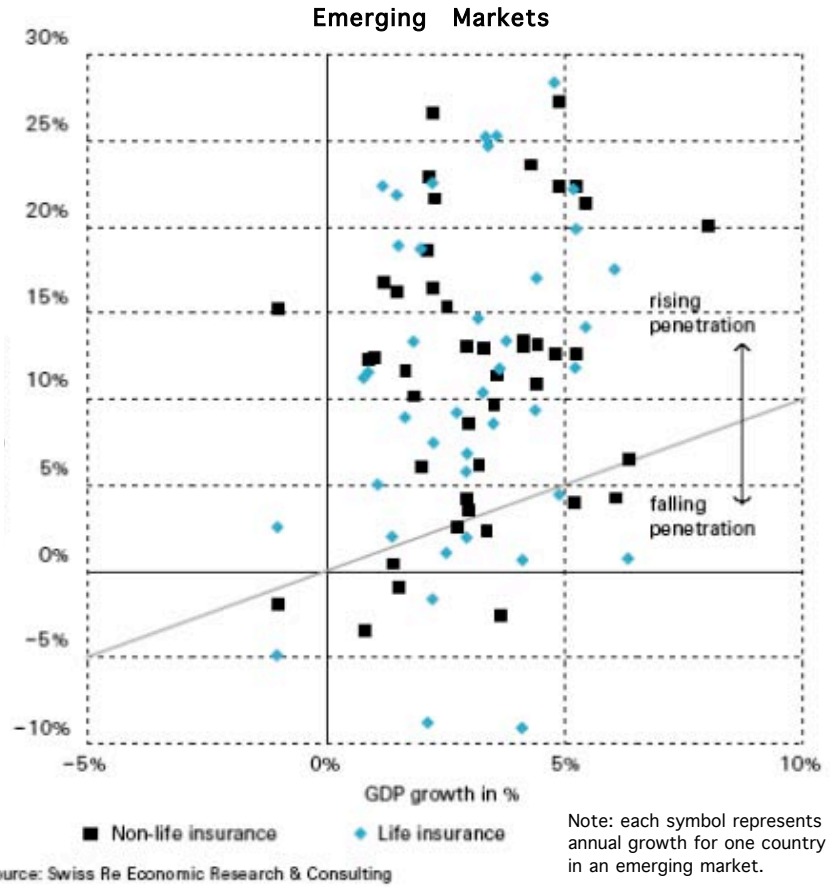
Already over $300 billion/year in premiums

Eleven Percent of $2.9 Trillion/year Global Insurance Market is in Developing Countries and Economies in Transition: 2003



Source: Swiss Re, Economic Research & Consulting, Sigma No. 3/2004 [Swiss Re (2004)]l. Includes property/casualty and life/health insurance.

Demand growing faster than GDP

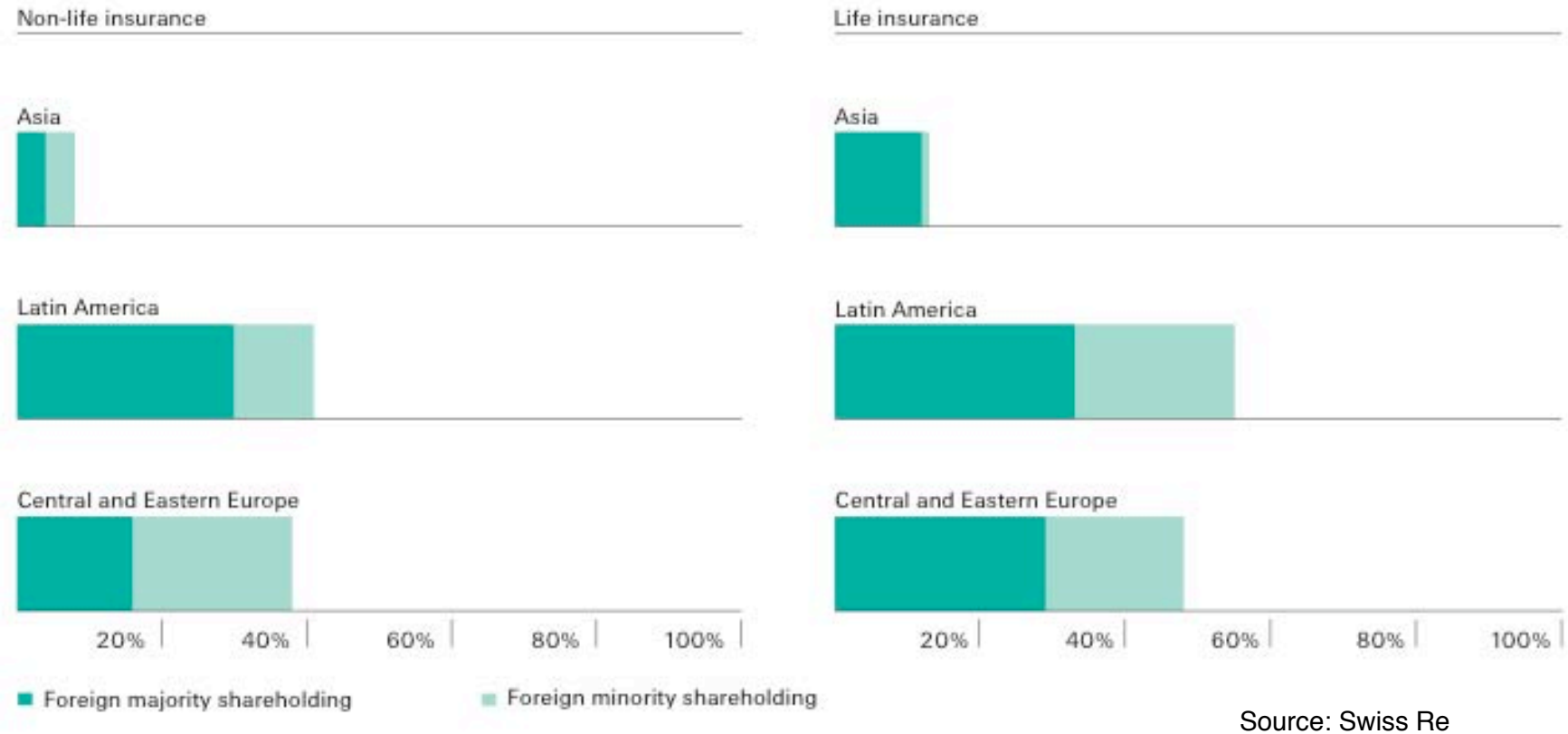


Source: Swiss Re Economic Research & Consulting

Note: each symbol represents annual growth for one country in an emerging market.

Economic Risks Rapidly Becoming Globalized

Foreign Participation in Insurance Ownership: 1998



Source: Swiss Re

Example: Insured losses from the 2004 Tsunami projected to fall between $5 and $10 billion

Response Options

- Reactive
  - Higher premiums
  - Higher deductibles
  - Lower limits
  - Exclusions
  - Non-renewal
  - Withdraw from markets
- Proactive
  - Building codes
  - Disaster preparedness; recovery; education
  - Public policy
  - Integrating emissions reduction and risk management
  - Science

--> Insurability is key issue

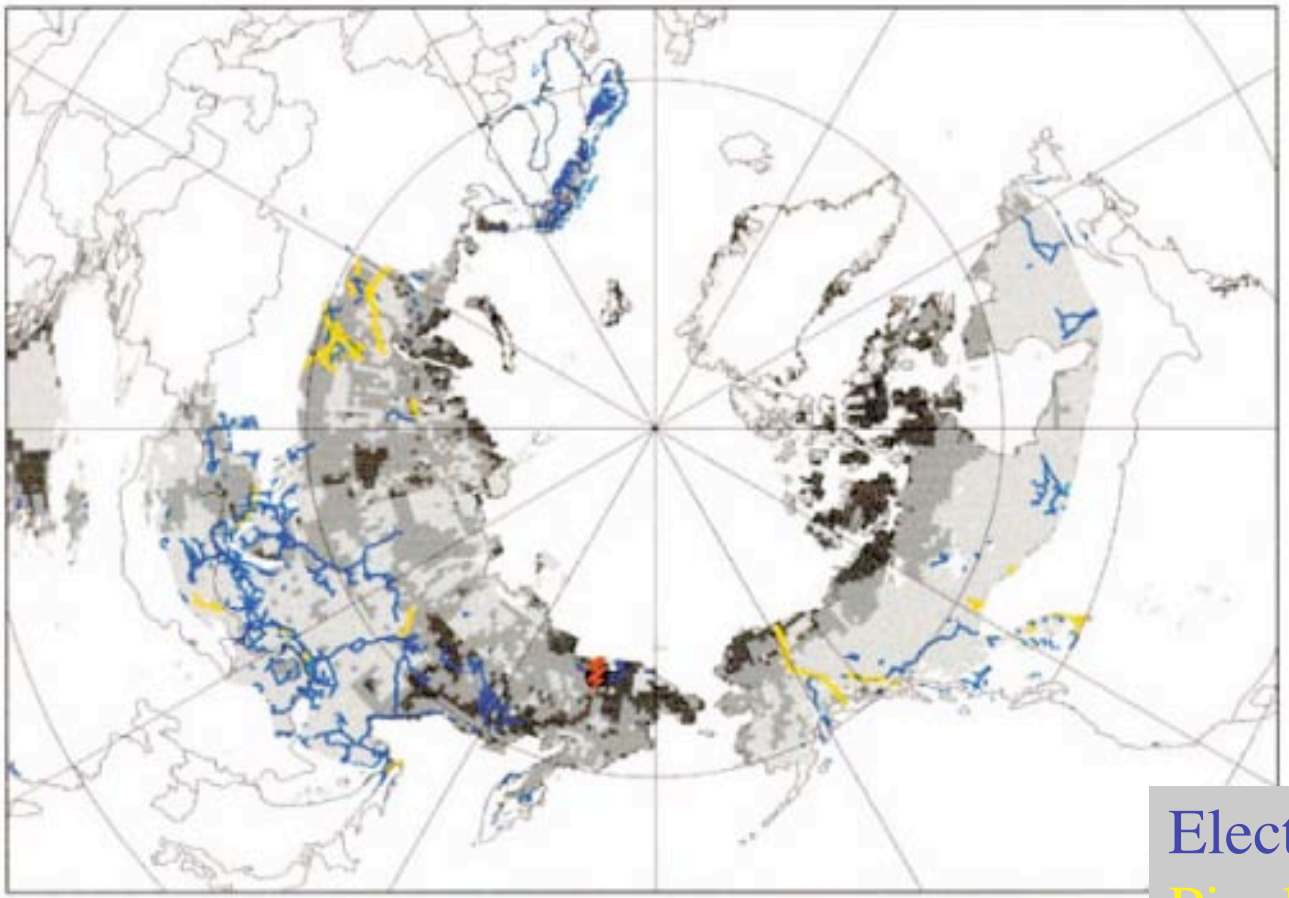
Integrating Energy Management & Risk Management

Energy-efficient torchiere lights also eliminate significant fire hazard

Where Science Meets Society
(Research Needs)

- Insurers have much to offer: historical data, current exposures, actuarial techniques
- No-regrets opportunities for insurers
- Needed: better understanding of the risk management dimensions of sustainable energy technologies
- Integration of historically-based "CAT" modeling with forward-looking climate modeling --> *maintain/increase insurability*

Value of Coupled Models: e.g. Permafrost Melt Hazard Potential



Settlement of several meters is possible.

Vulnerability:

- Buildings
- River terminals
- Natural gas production
- Pipelines
- Electric transmission
- Roadways/rail

Electrical transmission
Pipelines
Bilbino nuclear station

Nelson, et al. 2001 (*Nature*)

More Information

http://eetd.lbl.gov/insurance